

Final Report for Project No. 15-2644  
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Continued Analysis of EUVE Solar System Observations

G. Randall Gladstone  
Southwest Research Institute  
6220 Culebra Road  
San Antonio, TX 78238-5166

ph: 210-522-3581  
fax: 210-543-0052  
e-mail: [randy@whistler.space.swri.edu](mailto:randy@whistler.space.swri.edu)

# 1 Introduction and Overview

This is the final report for this project. We proposed to continue our work on extracting important results from the EUVE archive of lunar and jovian system observations. In particular, we planned to:

1. produce several monochromatic images of the Moon at the wavelengths of the brightest solar EUV emission lines,
2. search for evidence of soft X-ray emissions from the Moon and/or X-ray fluorescence at specific EUV wavelengths,
3. search for localized EUV and soft X-ray emissions associated with each of the Galilean satellites,
4. search for correlations between localized Io Plasma Torus (IPT) brightness and volcanic activity on Io,
5. search for soft X-ray emissions from Jupiter, and
6. determine the long term variability of He 58.4 nm emissions from Jupiter, and relate these to solar variability.

However, the ADP review panel suggested that the work concentrate on the Jupiter/IPT observations, and provided half the requested funding. Thus we have performed no work on the first two tasks, and instead concentrated on the last three. In addition we used funds from this project to support reduction and analysis of EUVE observations of Venus. While this was not part of the original statement of work, it is entirely in keeping with extracting important results from EUVE solar system observations.

## 2 First Year Results

During the first year, our plan was to 1) look for EUVE emissions associated with the Galilean satellites, and 2) determine the long-term variability of He 58.4 nm emissions from Jupiter. While we have kept up with the second task, and now have about 15 separate determinations of the He 58.4 nm disk brightness of Jupiter, we chose to delay the first task until the second year, and move a second year task, the search for temporal correlations in the IPT emissions, up to the first year. The reason for this was that we established a collaboration with Dr. Floyd Herbert of LPL (U. of Arizona), who has a long-standing interest in this problem. Accordingly, we reduced all of the EUVE IPT data for 1996 and produced orbit-by-orbit brightness determinations of the east and west ansae. These were analyzed by Dr. Herbert for periodicities, and the results presented at the MOP and DPS meetings.

The Venus work was presented at the DPS, and is being written up for publication in JGR.

### 3 Second Year Results

For the second year, we continued our IPT variability work, analyzing 400ks of new data acquired in support of the Galileo I24 encounter. A paper detailing the results has been accepted for publication by JGR. In this study we compared the I24 data of October 1999 with another well-studied period of EUVE data in June 1996. The results for the 1999 data compared to the 1996 data were 1) the electrons were hotter (5.4 vs. 4.6 eV), 2) the luminosity was higher (375 vs. 245 GW in the 35–73 nm region), 3) the mass was lower (by 10–15%), 4) the sulfur/oxygen ratio was larger (0.8 vs. 0.5), and 5) the ionization level was greater (1.2 vs 0.8 for  $[S^{++}]/[S^+]$  and 0.22 vs. 0.15 for  $[O^{++}]/[O^+]$ ). These results are consistent with the idea that electron temperature and density are anti-correlated. Estimates for corrections to several poorly-known electron impact collision strengths for EUV multiplet were also determined, e.g., the  $O^+/S^{++}$  48.4 nm feature is about ten times brighter than predicted using available collision strengths.

### 4 Papers Published:

Herbert, F., G. R. Gladstone, and G. E. Ballester, “Extreme Ultraviolet Explorer spectra of the Io plasma torus: Improved spectral resolution and new results,” *J. Geophys. Res.*, in press, 2001.

### 5 Papers Presented:

- Gladstone, G. R., F. Herbert, and N. Thomas, “EUVE Observations of Jupiter and the Io Plasma Torus,” (invited), The EUVE End-of-Mission Conference, Jenner, CA, July 22–24, 2001.
- Bagenal, F., A. Bouchez, M. Brown, M. Burger, G. R. Gladstone, F. Herbert, N. M. Schneider, N. Thomas, and C. Woodward, “Io Plasma Torus: Temporal and Spatial Variability,” Jupiter: Planet, Satellites, and Magnetosphere Meeting, Boulder, June 25–30, 2001.
- Herbert, F., G. R. Gladstone, and G. E. Ballester, “Moderate-Resolution EUV Spectra of the Io Plasma Torus,” Jupiter: Planet, Satellites, and Magnetosphere Meeting, Boulder, June 25–30, 2001.
- Herbert, F., and G. R. Gladstone, “Moderate-Resolution EUV Spectra of the Io Plasma Torus During the Galileo I24 Visit,” 32nd Annual Meeting of the Division for Planetary Sciences of the American Astronomical Society, Pasadena, 2000.
- Gladstone, G. R., S. A. Stern, D. C. Slater, and L. J. Paxton, EUVE Observations of the Venus Dayglow, 31st Annual Meeting of the Division for Planetary Sciences of the American Astronomical Society, Padova, Italy, 1999.
- Herbert, F., and G. R. Gladstone, Dynamical Time Scales in the Io Plasma Torus, 31st Annual Meeting of the Division for Planetary Sciences of the American Astronomical Society, Padova, Italy, 1999.
- Herbert, F., G. R. Gladstone, and B. R. Sandel, Electron Temperature in the Io Plasma Torus: The Key to Understanding Torus Energy Flow, Magnetospheres of the Outer Planets Conference, Paris, France, 1999.